

# **Pacific Sardine STAR Panel**

Southwest Fisheries Science Center  
La Jolla, California  
September 21 – 25, 2009

Report prepared for:

Center for Independent Experts

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## Executive Summary

- A STAR Panel met at the Southwest Fisheries Science Center, in La Jolla, California, from September 21 – 25, 2009 to review the stock assessment for Pacific sardine.
- The objective of the Panel was to conduct a detailed peer review of the results of the stock assessment, including data inputs and analytical models, and to summarize this evaluation clearly in a STAR Panel report to provide the best available scientific information to the Pacific Fisheries Management Council.
- A STAR Panel is normally convened once every three years to review the assessment for Pacific sardine. The last STAR Panel was held in 2007. The current Panel was formed one year in advance of schedule to address several concerns of the Pacific Fishery Management Council.
- Kevin Hill, from the Southwest Fisheries Science Center, presented the assessment methodology and results on behalf of the Stock Assessment Team. Tom Jagielo, from Tom Jagielo Consulting, presented the results of a 2009 west coast aerial sardine survey. This is the first time that an estimate of absolute abundance was available for Pacific sardines.
- The STAR Panel thoroughly reviewed the draft assessment and the aerial survey results and provided both the Stock Assessment Team and aerial survey analyst with detailed written requests (and rationales) during the meeting.
- Subsequent assessment re-analyses were motivated by the changes over time in the biomass time series evident from the retrospective analysis, very high estimates of fishing mortality ( $F$ ) in some years, poor residual patterns in the fits to age- and length-composition data for some fleets and years, concern over environmentally-driven and/or density-dependent changes in biological parameters, and seasonal effects on selectivity generated by shifts in fish distribution.
- The Panel welcomed the aerial survey and endorsed its use in the stock assessment. It noted that the survey coefficient of variation (CV) was extremely large and was probably due to spatial variation in density rather than sampling variation. The Panel was concerned with the relationship used to relate school area to school density as it implied a density of zero at an infinite school size. An alternate formulation was calculated during the meeting. The Panel was also concerned that the survey CV did not account for all uncertainty. This was also addressed (but not fully) during the meeting.
- The final base assessment, using the Stock Synthesis (version 3) model, included spawning biomass from daily egg production surveys as an estimate of relative abundance and the 2009 aerial survey result as an estimate of absolute abundance. The inclusion of the aerial survey abundance estimate did not change the trend in abundance but did markedly change the perception of current abundance, approximately doubling it. Analysis indicated that the model was very sensitive to

two states of biomass and that small input changes can have major impacts on the estimates of abundance.

- The STAR panel concluded that the final base model constituted the best available scientific information on the status of Pacific sardines off the west coast of North America and recommended that it be used for status determination and management in the Council process.

## Background

A STAR Panel met at the Southwest Fisheries Science Center (SWFSC), in La Jolla, California, from September 21 – 25, 2009 to review the stock assessment for Pacific sardine (*Sardinops sagax*).

The Panel consisted of four members, two from the Scientific and Statistical Committee (SSC), and two external reviewers, including myself. André Punt (SSC) chaired the Panel, Selina Heppell (SSC) acted as rapporteur, and Dvora Hart was the second external reviewer. In addition, there were three advisory representatives to the Panel: Mike Okoniewski from the Coastal Pelagic Species Advisory Subpanel (CPSAS), Briana Brady from the Coastal Pelagic Species Management Team (CPSMT), and Mike Burner from the Pacific Fishery Management Council (PFMC).

The meeting was also attended by numerous scientific staff from the SWFSC and by members of the general public representing different groups within the fishery.

The terms of reference for a Coastal Pelagic Species (CPS) stock assessment review, the proposed meeting agenda, and most background documents were posted and available for review on a PFMC FTP site by September 1, 2009. The assessment document was available on September 14, 2009 and a document describing the results of a 2009 aerial survey was available on the first day of the meeting, September 21, 2009.

The objective of the Panel was to conduct a detailed peer review of the results of the stock assessment, including data inputs and analytical models, and to summarize this evaluation clearly in a STAR Panel report to provide the best available scientific information to the PFMC.

Normally, a STAR Panel is convened once every three years to review the assessment for Pacific sardines. The last STAR Panel was held in 2007. It is my understanding that the current Panel was formed one year in advance of schedule for several reasons. An assessment update was presented to the PFMC in November 2008, based upon the index of abundance from daily egg production surveys (DEPM). The update indicated a decreasing trend in stock abundance and an acceptable biological catch (ABC) for 2009 of 66,932 mt. This represented a 25% decrease from the 2008 ABC / harvest guideline (HG) adopted by the PFMC. For various reasons, the CPSMT had concerns regarding the degree of consistency between the 2008 update and the 2007 stock assessment data and modeling results. The CPSAS also indicated that “the stock assessment does not reflect the reality reported by fishermen and spotter planes over the last eight years and it is clear that a second index of abundance is absolutely necessary”. To address these concerns, the PFMC convened a STAR Panel in May 2009.

The current Panel benefited greatly from two reports produced by the May 2009 STAR Panel. The first report reviewed the DEPM, the only abundance index used in the assessment model for Pacific sardine in recent years. The report recommended several changes to the DEPM prior to the 2009 assessment. The second report reviewed aerial survey methods for Pacific sardine. A synoptic survey to estimate Pacific sardine abundance had been recommended by STAR Panels since 2004. A trial survey was

coordinated and conducted by industry in 2008. The Panel reviewed the results of the 2008 survey and provided recommendations for an aerial survey to be conducted in 2009.

This set the background for the current STAR Panel. Kevin Hill, from the SWFSC, presented the assessment methodology and results on behalf of the Stock Assessment Team (STAT). Tom Jagielo, from Tom Jagielo Consulting, presented the results of the 2009 west coast aerial sardine survey. This is the first time that an estimate of absolute abundance was available for Pacific sardine.

I would be remiss if I did not acknowledge several individuals. The STAR Panel provided a thorough review of the stock assessment and the 2009 aerial survey. This was facilitated by the excellent leadership of the Chair, André Punt. His professional and proficient manner ensured that the Panel completed its objectives within the allotted time. Selina Heppell did a remarkable job as rapporteur, capturing all discussions succinctly, while still contributing to the review. Dvora Hart provided an independent perspective to the review and contributed greatly to improving the analysis of the aerial survey. The advisors to the Panel provided a vital role. Mike Okoniewski presented an industry perspective and ensured that the Panel was cognizant of its actions as it related to the fishery. Briana Brady kept the Panel focused on the objectives of the CPSMT. Mike Burner managed the flow of documents in a timely manner and provided an important link between the Panel and the PFMS. The STAT, in particular Kevin Hill and Nancy Lo, are to be commended for their thorough presentation of the assessment and for the countless hours spent during the week answering many requests by the Panel; they left no requests unanswered. Similarly, Tom Jagielo is to be commended for his excellent analysis and presentation of the aerial survey results, all of which had to be completed in a very tight time frame prior to the meeting.

## **Description of Reviewer's Role in Review Activities**

The terms of reference for a CPS stock assessment review, the proposed meeting agenda, and most background documents were posted by Mike Burner (PFMC) on an FTP site approximately three weeks prior to the STAR Panel review. Similarly, the assessment document was made available on the FTP site approximately one week prior to the meeting. I read and reviewed all of these documents prior to the meeting. A document describing the results of the 2009 aerial survey was not available until the first day of the meeting.

It should be noted that the assessment and aerial survey documents were not available within the pre-review deadline (September 7, 2009) set by the Center for Independent Experts (CIE). Given their workloads and the time frame, it was impossible for the STAT and survey analysts to meet this deadline. I have included a recommendation in the "Conclusions and Recommendations" section to address this issue.

During the STAR Panel review, detailed presentations were given by both the STAT and aerial survey analyst. These presentations were followed by extensive question, discussion, and review periods. On multiple occasions, the presenters were asked to provide further analyses which were subsequently reviewed during the meeting. The STAR Panel also conducted its own analyses during the meeting.

Before the meeting concluded, the Panel wrote a first draft of the STAR Panel report. This was compiled by the Chair and was based primarily upon the notes of the rapporteur, with contributions from Dvora Hart and myself. The first draft was reviewed by the Panel, panel advisors, the STAT, and the aerial survey analyst before the meeting ended. Subsequent to the meeting, the Chair distributed a second draft of the report, to which I provided further comments. The final report was distributed in early October.

## Summary of Findings

In its terms of reference for STAR Panels, the PFMC identifies the following four terms:

1. Reviewing draft stock assessment documents and other pertinent information (e.g.; previous assessments and STAR Panel reports, if available);
2. working with STAT Teams to ensure assessments are reviewed as needed;
3. documenting meeting discussions; and
4. reviewing summaries of stock status (prepared by STAT Teams) for inclusion in the Stock Assessment and Fishery Evaluation (SAFE) document.

In the terms of reference for CIE reviewers (Appendix 2, Annex 2), this is expanded to seven terms, each of which will be addressed in this section:

1. Reviewing draft stock assessment documents and other pertinent information (e.g.; previous assessments and STAR Panel reports);
2. working with STAT Teams to ensure assessments are reviewed as needed;
3. documenting meeting discussions;
4. providing evaluation and recommendations regarding data quality, analytic methodologies, model assumptions, estimates, uncertainty, result interpretation and conclusions;
5. recommending alternative methods and/or modifications of proposed methods, as appropriate during the STAR Panel meeting;
6. reviewing summaries of stock status (prepared by STAT Teams) for inclusion in the Stock Assessment and Fishery Evaluation (SAFE) document, and;
7. providing an explicit statement as to whether this assessment represents the best available science.

*ToR #1: reviewing draft stock assessment documents and other pertinent information (e.g.; previous assessments and STAR Panel reports)*

The Panel spent most of the available time reviewing the draft stock assessment and results of the 2009 aerial survey. Background information, previous assessments, and STAR Panel reports were available prior to the meeting, and it was assumed that Panel members had reviewed them and were familiar with their content.

It was apparent during the meeting that members of the STAR Panel had reviewed the draft assessment document prior to the meeting and were familiar with the assessment model being used. Unfortunately, the aerial survey document was not available prior to the meeting. However, as Panel members were familiar with the survey design recommended by the May 2009 STAR Panel, it did not take long to “get up to speed” on the survey results.

*ToR #2: working with STAT Teams to ensure assessments are reviewed as needed*

Kevin Hill gave a detailed presentation on the assessment methodology and results from a draft assessment, using the Stock Synthesis (version 3) model (SS3). In his presentation, he highlighted how the draft assessment differed from that on which the 2007 assessment was based. The draft assessment also included several revisions to the DEPM, as recommended by the May 2009 STAR Panel.

Similarly, Tom Jagielo presented the results of the 2009 aerial survey, designed to estimate absolute abundance. The survey was two staged, as recommended by the May 2009 STAR Panel. The first stage was to collect data on the number and size (surface area) of sardine schools on three replicates of 52 transects. The second stage was to collect 52 point sets to determine the relationship between school area and school density.

The Panel worked diligently throughout the meeting with both the STAT and the aerial survey analyst. As indicated under ToR # 5, the Panel provided numerous written requests for re-analyses and sensitivity tests.

*ToR #3: documenting meeting discussions*

The Panel provided detailed documentation of the meeting discussions in the STAR Panel Report. In particular, the Panel provided both the STAT and aerial survey analyst with detailed written requests (and rationales) during the meeting (see ToR #5). For the most part, there were clear linkages between successive requests which led, eventually, to the Panel's conclusions.

*ToR #4: providing evaluation and recommendations regarding data quality, analytic methodologies, model assumptions, estimates, uncertainty, result interpretation and conclusions*

In his presentation of the draft assessment, Kevin Hill indicated that the 2009 draft differed from the 2007 assessment in several respects:

1. The use of bi-annual (semester; S1 (July-Dec) and S2 (Jan-June)) rather than quarterly time-steps,
2. separation of the California fishery into southern and central California fisheries,
3. the use of weighted rather than unweighted length-frequencies and conditional ages-at-length for all fisheries rather than just the California fishery,
4. the use of different population length-bins,
5. the use of the hybrid option to estimate  $F$ , and (f) different assumptions regarding selectivity,
6. treatment of the early (1981-1990; EAR) and more recent (1991+; LATE) data for the Ensenada and southern California fisheries as separate fisheries,
7. the use of revised estimates of spawning biomass from the DEPM as an index of relative abundance.



The Panel concurred that the use of a two semester model was an improvement as the aggregated data minimized variability. The Panel was concerned that no catch data were available from the 2009 Ensenada (ENS) fishery as this had a major impact on the estimate of continuous  $F$  in 2009. Most of the discussion and subsequent re-analyses was motivated by the changes over time in the biomass time series evident from the retrospective analysis, very high estimates of fishing mortality ( $F$ ) in some years, poor residual patterns in the fits to age- and length-composition data for some fleets and years, concern over environmentally-driven and/or density-dependent changes in biological parameters, and seasonal effects on selectivity generated by shifts in fish distribution.

The Panel reviewed changes to the DEPM, as recommended by the May 2009 STAR Panel. It noted that estimates of spawning biomass for the early part of the time series were now calculated consistently with more recent DEPM estimates. DEPM estimates were also input into the assessment model as the spawning biomass of females only; this eliminated the need to calculate sex ratios, as had been done in the past. The final DEPM time series was based on the sum of the DEPM spawning biomass estimates in each of two regions. The DEPM does not measure spawning biomass throughout the entire distributional range, and therefore assumes proportionality and linearity between areas. It is important to know if the proportion of fish spawning in northern areas has increased over time; if so, this would reduce the proportion spawning within the survey area and introduce a negative bias. The Panel found no evidence that the trend of DEPM is incorrect; however, there were concerns as to scaling it.

In his presentation on the 2009 aerial survey results, Tom Jagielo indicated that the surveys had followed most of the recommendations of the May 2009 STAR Panel. One change was made; the survey was flown at an altitude of 4,000 ft, rather than the recommended 8000 ft. This allowed for better school identification and also allowed the survey to continue when cloud cover was lower than 8,000 ft. Due to bad weather conditions, only 41 of 52 transects were surveyed. Three replicates of the 52 transects were to have been flown; this objective was not met. At sea sampling resulted in 80 point sets being taken, 33 from the north and 47 from the south. However, of these, only 28 (all from the north) could be used for density estimation. The estimate of abundance from the survey was 1,403,504 mt, with a standard error of 698,284 mt.

The Panel welcomed the survey and endorsed its use in the stock assessment. It noted that the survey CV was extremely large and was probably due to spatial variation in density rather than sampling variation. The Panel was concerned with the relationship used to relate school area to school density as it implied a density of zero at an infinite school size. An alternate formulation was calculated during the meeting. The Panel was also concerned that the survey CV did not account for all uncertainty. This was also addressed (but not fully) during the meeting.

There was a discussion regarding other aspects of the survey. The measurement of the edge of schools, from aerial photographs, was seen to be a potential source of error. Similarly, the method of accounting for schools that extend beyond the edge of a photograph was questioned due to the non-linearity of the school area / school density relationship. It was also noted the abundance estimate may be negatively biased as not all schools are measured due to an unknown percentage being too deep in the water column

to be seen from the air. There were some concerns regarding the subjective manner that non-sardine schools were removed from the analysis based upon a visual identification of school shape. Industry representatives also noted the impact of not surveying 11 transects in the south, in an area that sardines were in a fishery immediately subsequent to the survey.

*ToR #5: recommending alternative methods and/or modifications of proposed methods, as appropriate during the STAR Panel meeting*

The Panel provided the following 19 requests to the STAT during the meeting. The rationales and responses are detailed in the Panel Report:

1. Plot the selectivity and growth curves for each retrospective run and perform a sensitivity analysis to assess the influence of different data inputs by doubling the weights on the index, and age- and length-composition data for the four fisheries one at a time.
2. Identify the effects of age- and length-composition data from each fishery on the likelihood profiles for natural mortality ( $M$ ).
3. Determine the effects of aging error on model results by adding a linear bias to the age compositions.
4. Re-run the assessment assuming a Beverton-Holt stock-recruitment relationship.
5. Add the new aerial survey results to the assessment and examine the sensitivity of the assessment to a range of (assumed) coefficients of variation for the biomass estimate; estimate selectivity for the aerial survey.
6. Explore the effects of blocking growth and/or selectivity curves.
7. Explore alternative time blocking on selectivities.
8. Add seasonal (semester) selectivities to California fisheries.
9. Identify the effects of age- and length-composition data from each fishery on the likelihood profiles for natural mortality ( $M$ ).
10. Conduct a sensitivity analysis accounting for aging error.
11. Re-run the assessment assuming a Beverton-Holt stock-recruitment relationship.
12. Explore the influence of high British Columbia catch in 2008 on model results.
13. Estimate  $M$  separately for the same time blocks used for growth.
14. Add aerial survey data to the model and run a sensitivity on the coefficient of variation of the biomass estimate.
15. Run final base model with Beverton-Holt stock-recruitment relationship.
16. Add WCVI night estimates (2006, 2008, and 2009) to the model as a sensitivity analysis.
17. Run a likelihood profile on the aerial survey catchability ( $q$ ).
18. Document response of the model to “Jitter” analysis to avoid local minima.
19. The draft document should be modified to include a more thorough description of the analysis on which PFFS index is based.

Similarly, the Panel provided the following nine requests to the aerial survey analyst:

1. Annotate the school density and weight data by the years concerned.

2. Compute the variances of the estimates of abundance from the 2008 aerial surveys using a between-transect estimator.
3. Estimate abundance (and its CV) using only the data for the northern stratum.
4. Compute the confidence and prediction intervals for the relationship between school area and weight.
5. Plot the weighted and raw length frequency data from the 2009 aerial survey.
6. Fit the school weight and surface area data for 2008 and 2009 and test whether the data are consistent with pooling the data.
7. Explore the sensitivity of estimating biomass using the relationship between school surface area and school density to estimate the weight of all schools compared to using the lowest measured density for large schools that are outside the bounds of the relationship.
8. Fit the data on school weight and school size to a Michaelis-Menten model assuming log-normal error, i.e.,  $\ln(\text{Density}) = (a + b \cdot \text{Area}) / (c + \text{Area})$ .
9. Quantify the uncertainty associated with the 2009 estimate of abundance taking account of both the between-transect variation and the uncertainty related to the relationship between school density and school area.

The final base model included the following changes from the draft model:

1. Allowing growth to differ between 1981-90 and 1991+,
2. changing the time-blocking for CCA selectivity,
3. combining the early and later fisheries for Ensenada and southern California,
4. fitting the California fisheries in semesters one and two with separate selectivities,
5. including the 2009 aerial survey estimate of absolute abundance, and
6. not bias-correcting the 2008 and 2009 recruitments.

*ToR #6: reviewing summaries of stock status (prepared by STAT Teams) for inclusion in the Stock Assessment and Fishery Evaluation (SAFE) document*

This term of reference was not addressed by the Panel. As it was not mentioned during the meeting, it is unclear if this is still done. On several occasions, the STAT was requested to add certain analyses to the final assessment report. I can only assume that the final assessment report serves as the summary of stock status.

*ToR #7: providing an explicit statement as to whether this assessment represents the best available science.*

The STAR panel concluded that the final base model constitutes the best available scientific information on the status of Pacific sardines off the west coast of North America and recommended that it be used for status determination and management in the Council process. I concur with this conclusion.

## Conclusions and Recommendations

The final base model, accepted by the Panel, represents the best scientific information currently available on the status of Pacific sardine off the west coast of North America. However, as all involved with the assessment would probably agree, the resulting current biomass estimate is very tenuous.

The model, with the inclusion of the DEPM relative abundance index only, provides reliable information on trends in abundance. However, minor changes to input data can produce major changes to estimates of absolute biomass. Although it could not be documented, there was concern that the DEPM did not provide an index of spawning biomass across the entire stock range. The Panel recognized this and decided, rightly so, to include the results of the 2009 aerial survey in the base model as an absolute estimate of abundance to “anchor” the model. The aerial survey estimate had an extremely large CV. However, the survey design had been reviewed by the May 2009 STAR Panel, the 2009 survey had followed the recommended survey design, and this Panel re-formulated the relationship between school area and school density and also accounted for more of the survey uncertainty. The Panel acknowledged the need for more point sets as these are critical to the relationship between school area and school density and the subsequent conversion to biomass.

The inclusion of the aerial survey abundance estimate markedly changed the current perception of abundance, approximately doubling it. It is reassuring that the inclusion of the aerial survey abundance estimate was not in major conflict with the relative abundance data from the DEPM. However, this is also disturbing as it shows how easily one can be influenced by the model-based relative estimates of abundance.

The STAT and Panel spent most of the week “fine tuning” the model. However, the final model, excluding the aerial survey abundance estimate, essentially showed the same trends in abundance as the initial draft model presented by the STAT. Again, this is reassuring and it was important to conduct these analyses. However, it also shows that greater priority should perhaps be given to improving current indices and adding others, more so than improving the model. The aerial survey estimate was critical to this assessment; it is imperative that the survey be continued annually for the foreseeable future.

The Panel’s greatest concern with the aerial survey was not in its design but in the variance around the point estimate of absolute abundance. Recommendations were made to stratify the survey area, to determine the percentage of schools visible to the survey, and to improve estimates of school sizes. However, the Panel focused primarily on accounting for all sources of uncertainty in the survey, including inter-transect variation in density, the uncertainty about the relationship between school area and school density, the variation among schools within this relationship, and the uncertainty in the estimate of school sizes. The Panel grappled with this issue as the estimate of absolute biomass is highly sensitive to the estimated biomass of large schools and the biomass of these schools is highly uncertain due to a lack of point sets on large schools.

It is this uncertainty which must be evaluated, and hopefully reduced, before the next assessment. The STAT, in one of its analyses (Panel report request “N”) demonstrated the model sensitivity to a change in the CV of the aerial survey estimate of abundance. When the survey CV was decreased from 0.50 to 0.45, there was no difference in the trend in biomass but there was a substantial difference in scale. The 2009 estimate of age 1+ biomass increased from 0.88 million mt to 2.53 million mt! The analysis indicated that the model is very sensitive to two states of biomass and that small changes in the aerial survey CV can have major impacts on the estimates of current biomass.

The Panel made several recommendations for future aerial surveys. It highlighted the importance of collecting more point sets for inclusion in the relationship between school area and school density. This may reduce the uncertainty of this relationship; such point sets would also provide valuable information on inter-annual changes, spatial (north vs. south) changes, and environmental (e.g.: temperature) impacts. It was also suggested that more vessels be used to collect point sets and that point sets could be collected during the fishery; the Panel endorsed this as long as it did not impact on the synopticity of the survey. The Panel also indicated the importance of surveying more transects, as this may reduce spatial variation. It was suggested by an industry representative that faster aircraft could be used. The Panel also noted the importance of determining the percentage of schools that are not visible on transects. It was recommended that acoustic technology be used to examine schools in the water column that are not visible from the air. Acoustics may also be used to estimate the size of large schools that cannot be caught in point sets.

The Panel determined that the CV of the 2009 aerial survey estimate was at least 0.52. However, it was not possible, during the meeting, to calculate all of the uncertainty around this estimate. The Panel chose to scale the CV upward to 0.55; this choice was somewhat arbitrary. Given the sensitivity of the model to the choice of CV, it may have been beneficial to show the impact of choosing a CV = 0.55 versus a CV = 0.54 or 0.56.

There was an interesting discussion during the meeting regarding the level of scrutiny applied to the aerial survey data compared to some of the other data streams in the assessment model. For example, there are no confidence limits on the catch data, and all of the uncertainty is not captured around the DEPM estimates.

This assessment has shown the importance of being able to quantify the model with an estimate of absolute abundance. It has also shown the importance of including additional indices of abundance, to supplement the DEPM. The STAT considered two such indices in the assessment document, the Northwest Fisheries Science Center Predator / Forage Fish Survey (PFFS), and the West Coast Vancouver Island trawl survey (WCVI). Neither was included in the draft model. The former was excluded primarily as it represented a very small spatial area along the Pacific coast. The latter was excluded as raw survey data were not available to the STAT and there was uncertainty regarding a change from day to night surveying part way through the time series. The Panel also recommended that other surveys (e.g.: acoustic surveys) be evaluated as potential indices of abundance.

The WCVI trawl survey should be further evaluated prior to the next assessment. It is an important link to the assessment as it provides an index of abundance in Canadian waters. The survey encompasses a broad geographical area, approximately 450 km along the west

coast of Vancouver Island, during the summer period when Pacific sardines are expected to have migrated northward. Three surveys (2006, 2008, and 2009) have been conducted since the survey design changed from a day to night survey and a fourth (2010) may be available before the next assessment. This index is important as it provides information beyond the geographical range of the DEPM and the aerial survey at approximately the same time as the aerial survey. A preliminary sensitivity analysis (Panel report request "P") indicated that the inclusion of the 2006, 2008, and 2009 estimates in the model caused a marked increase in the estimate of current biomass. Once again, this showed the sensitivity of the model to two states; this analysis was consistent with estimates assuming a lower CV on the aerial survey estimate. However, the analysis also indicated a high biomass (500,000 mt) prior to the stock recovery in the early 1980s. This analysis was very preliminary as it included arbitrary CV estimates (0.50). It is uncertain what would happen with more realistic CVs and highlights the importance of further evaluating this index.

The inclusion of the WCVI survey, or other indices, in the base model, points out a potential flaw in the PFMC assessment process. Currently, a STAR Panel is scheduled every three years to review the assessment of Pacific Sardines. In the intervening years, an assessment update is provided, which precludes the addition of indices. In theory, the WCVI survey may not be included in the assessment model until 2012. Given that these data are currently available, it suggests that the Council may not necessarily receive the best possible science. Unless the Council changes its terms of reference, I recommend that a STAR Panel be convened as soon as possible to review these data (and any other potential indices).

The Panel noted in its report that the estimate of combined total catch by the U.S., Mexico and Canada for 2008 exceeded that implied by the harvest guideline for the entire stock based on the 2008 assessment. If this continues, it could have a serious negative impact on the stock. A multi-national assessment is required to address this and many other issues. An annual tri-national forum is currently held; this should be expanded to include a tri-national assessment.

Concerns were also expressed during this review regarding the timing of the assessment. Given the nature of the fishery, with three separate openings, the aerial survey must be conducted in the July / August period. This leaves little time for a thorough analysis of the survey results prior to a September assessment. Consideration should be given to changing the assessment until later in the year. This may require changing the management schedule from its current calendar year basis. If such a change is not possible, then the deadline for the availability of assessment and survey documents should be reviewed and revised.

I have one final recommendation. There is currently a contradiction in the terms of reference provided by the PFMC and the CIE. The PFMC indicates that the STAR Panel is responsible for determining if a stock assessment is sufficiently complete and that this decision should be made by consensus. The CIE indicates that its reviewer is not required to reach a consensus and should instead provide a brief summary of independent views on the summary of findings and conclusions reached by the review panel. This did not pose any problems during the current review. However, it should be addressed by the PFMC and CIE for future Panels.

In conclusion, I have now had the opportunity to sit twice as a CIE reviewer for the Pacific sardine assessment, on the initial STAR Panel in 2004 and again in 2009. The STAT has made major improvements to the assessment in the intervening five years. In 2004, the Panel was primarily focused on the most appropriate framework for conducting future assessments. The STAT has advanced well since then, first using an age-structured assessment program (ASAP) and now the SS3 model. Some concerns raised in 2004 still remain; stock structure and migration patterns are still not fully understood. This must be resolved as it is crucial to some of the model assumptions. Some concerns raised in 2004 have been addressed; the development of the industry-based aerial survey is a major achievement.

## Appendix 1. Bibliography of Materials Provided for Review

### A) Assessment Documents (Current and Historical)

Hill, K. T., E. Dorval, N. C. H. Lo, B. J. Macewicz, C. Show, and R. Felix-Uraga. 2007. Assessment of the Pacific sardine resource in 2007 for U.S. management in 2008. NOAA-TM-NMFS-SWFSC-413.

Hill, K. T., E. Dorval, N. C. H. Lo, B. J. Macewicz, C. Show, and R. Felix-Uraga. 2008. Assessment of the Pacific sardine resource in 2008 for U.S. management in 2009.

Hill, K. T., N. C. H. Lo, B. J. Macewicz, and P. R. Crone. 2009. Assessment of the Pacific sardine resource in 2009 for U.S. management in 2010.

### B) Survey Reports and Methodologies – Egg Production Method and Aerial Surveys

Lo, N. C. H., B. J. Macewicz, D. Griffith, and R. L. Charter. 2008. Spawning biomass of Pacific Sardine (*Sardinops sagax*) of U.S. in 2008. NOAA-TM-NMFS-SWFSC-430.

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Jagiello, T. 2009. West coast aerial sardine survey draft report - sampling results in 2009. Pre-STAR Panel Draft - September 18, 2009. Also: Appendices I – IV sampling results in 2009 – west coast aerial sardine survey.

Jagiello, T. 2009. West coast sardine survey - application for Exempted Fishing Permit in 2009. Submitted April 27, 2009.



### C) Description of Assessment Models

Methot, R. D. 2005. Technical description of the Stock Synthesis II assessment program, Version 1.17 – March 2005. NOAA Fisheries, Seattle, WA.

Methot, R. D. 2009. User manual for Stock Synthesis model version 3.03a, updated May 11, 2009. NOAA Fisheries, Seattle, WA.

### D) STAR Panel Reports

Pacific Sardine STAR Panel Meeting Report, NOAA / Southwest Fisheries Science Center La Jolla, California, September 18-21, 2007.

Aerial Survey Methods for Pacific Sardine, Report of STAR Panel Meeting, NOAA / Southwest Fisheries Science Center La Jolla, California, May 4-8, 2009.

Daily Egg Production Methods for Pacific Sardine, Report of STAR Panel Meeting, NOAA / Southwest Fisheries Science Center La Jolla, California, May 4-8, 2009.

### E) CPSAS Reports

Coastal Pelagic Species Advisory Subpanel supplemental report on Pacific sardine and Pacific mackerel management, November 2007.

Coastal Pelagic Species Advisory Subpanel report on the Pacific sardine stock assessment and management measures, November 2008.

Coastal Pelagic Species Advisory Subpanel supplemental report on an exempted fishing permit (EFP) for sardine research, June 2009.

### F) CPSMT Reports and Statements

Coastal Pelagic Species Management Team supplemental statement on Pacific sardine and Pacific mackerel management, November 2007.

Coastal Pelagic Species Management Team report on Pacific sardine stock assessment and management measures, November 2008.

Coastal Pelagic Species Management Team supplemental report 2 on Pacific sardine stock assessment and management measures, November 2008.

Coastal Pelagic Species Management Team supplemental report on survey methodology review and exempted fishing permit (EFP), June 2009.

### G) SSC Reports

Scientific and Statistical Committee supplemental report on Pacific sardine and Pacific mackerel management, November 2007.

Coastal Pelagic Species Subcommittee of the Scientific and Statistical Committee report on Pacific sardine stock assessment and management measures, November 2007.

Scientific and Statistical Committee supplemental report on Pacific sardine stock assessment and management measures, November 2008.

### H) Other Documents

Terms of Reference for a Coastal Pelagic Species stock assessment review process, Pacific Management Council, April 2009.

Proposed agenda: Coastal Pelagic Species Stock Assessment Review Panel Meeting September 21-25, 2009.

Pacific Fishery Management Council Meeting Notice STAR Panel Meeting to Review Pacific Sardine Survey Results and Stock Status, September 21-25, 2009.

Schweigert, J. and G. McFarlane. 2001. Stock assessment and recommended harvest for Pacific sardine in 2002. Canadian Science Advisory Secretariat research Document 2001/126.

## **Appendix 2. Copy of the CIE Statement of Work**

### **Statement of Work for John Wheeler**

#### **External Independent Peer Review by the Center for Independent Experts**

#### **STAR Panel Review of Pacific Sardine Stock Assessment**

**Scope of Work and CIE Process:** The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract to provide external expertise through the Center for Independent Experts (CIE) to conduct impartial and independent peer reviews of NMFS scientific projects. This Statement of Work (SoW) described herein was established by the NMFS Contracting Officer's Technical Representative (COTR) and CIE based on the peer review requirements submitted by NMFS Project Contact. The CIE reviewer is selected by the CIE Coordination Team and Steering Committee to conduct the peer review of NMFS science with project specific Terms of Reference (ToRs). The CIE reviewer shall produce a CIE independent peer review report with specific format and content requirements (**Annex 1**). This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project.

**Project Description:** The Pacific sardine stock is assessed annually by SWFSC scientists, and the PFMC uses the resulting biomass estimate to establish an annual harvest level. This has a large potential impact on the fishery (up to 25-40% of the ex-vessel value). The stock assessment data and model are formally reviewed by a Stock Assessment Review (STAR) Panel once every three years, with the SSC reviewing updates in interim years. Independent peer review is required by the PFMC review process. The purpose of the STAR Panel will be to review draft stock assessment documents and any other pertinent information for Pacific sardine, work with the stock assessment teams to make necessary revisions, and produce a STAR Panel report for use by the PFMC and other interested persons for developing management recommendations for the fishery. The Terms of Reference (ToRs) of the peer review are attached in **Annex 2**.

**Requirements for CIE Reviewer:** One CIE reviewer shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. The CIE reviewer's duties shall not exceed a maximum of 14 days to complete all work tasks of the peer review described herein. The CIE reviewer shall have the expertise, background, and experience to complete an independent peer review in accordance with the SoW and ToRs herein. The CIE reviewer shall have expertise in stock assessment of coastal pelagic species; familiarity with age- or length-structured forward simulation models; design and analysis of fishery-independent surveys and time series.

**Location of Peer Review:** The CIE reviewer shall conduct an independent peer review during the panel review meeting scheduled at the Southwest Fisheries Science Center in La Jolla, California during 21-25 September, 2009.

**Statement of Tasks:** The CIE reviewer shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein.

Prior to the Peer Review: Upon completion of the CIE reviewer selection by the CIE Steering committee, the CIE shall provide the CIE reviewer information (name, affiliation, and contact details) to the COTR, who forwards this information to the NMFS Project Contact no later the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to the CIE reviewer. The NMFS Project Contact is responsible for providing the CIE reviewer with the background documents, reports, foreign national security clearance, and information concerning other pertinent meeting arrangements. The NMFS Project Contact is also responsible for providing the Chair a copy of the SoW in advance of the panel review meeting. Any changes to the SoW or ToRs must be made through the COTR prior to the commencement of the peer review.

Foreign National Security Clearance: The NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for the CIE reviewer who is a non-US citizen. For this reason, the CIE reviewer shall provide requested information (e.g., name, contact information, birth date, passport number, travel dates, and country of origin) to the NMFS Project Clearance for the purpose of their security clearance, and this information shall be submitted at least 30 days before the peer review in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations (available at the Deemed Exports NAO website: <http://deemedexports.noaa.gov/sponsor.html>).

Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will send by electronic mail or make available at an FTP site the CIE reviewer all necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE on where to send documents. The CIE reviewer shall read all documents in preparation for the peer review.

This list of pre-review documents may be updated up to two weeks before the peer review. Any delays in submission of pre-review documents for the CIE peer review will result in delays with the CIE peer review process, including a SoW modification to the schedule of milestones and deliverables. Furthermore, the CIE reviewer is responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein.

Panel Review Meeting: The CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs. **Modifications to the SoW and ToRs cannot be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COTR and CIE Lead Coordinator.** The CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the ToRs as

specified in the contract SoW. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

**Contract Deliverables - Independent CIE Peer Review Reports:** The CIE reviewer shall complete an independent peer review report in accordance with the SoW. The CIE reviewer shall complete the independent peer review according to required format and content as described in Annex 1. The CIE reviewer shall complete the independent peer review addressing each ToR as described in Annex 2.

**Other Tasks:** The CIE reviewer serves as an independent peer reviewer, therefore should not serve in the role of Chair. The CIE reviewer is required to deliver an independent peer review report, and may assist the Chair of the panel review meeting with contributions to a Summary Report. The CIE reviewer is not required to reach a consensus, and should instead provide a brief summary of independent views on the summary of findings and conclusions reached by the review panel in accordance with the ToRs.

**Specific Tasks for the CIE Reviewer:** The following chronological list of tasks shall be completed by the CIE reviewer in a timely manner as specified in the

#### **Schedule of Milestones and Deliverables.**

- 1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review;
- 2) Participate during the panel review meeting at the Southwest Fisheries Science Center (La Jolla, California), 21-25 September 2009, as called for in the SoW, and conduct an independent peer review in accordance with the ToRs (Annex 2);
- 3) No later than 23 October 2009, the CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shrivani, CIE Lead Coordinator, via email to [shivlanim@bellsouth.net](mailto:shivlanim@bellsouth.net), and CIE Regional Coordinator, via email to David Die ([ddie@rsmas.miami.edu](mailto:ddie@rsmas.miami.edu)). The CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in Annex 2;
- 4) The CIE reviewer shall address changes as required by the CIE review in accordance with the schedule of milestones and deliverables.

**Schedule of Milestones and Deliverables:** CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

<b><i>27 July 2009</i></b>	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact
<b><i>7 September</i></b>	NMFS Project Contact sends the CIE Reviewer the pre-review documents
<b><i>21-25 September</i></b>	The reviewer participates and conducts an independent peer review during the panel review meeting
<b><i>9 October</i></b>	CIE reviewer submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
<b><i>23 October</i></b>	CIE submits CIE independent peer review reports to the COTR
<b><i>30 October 2009</i></b>	The COTR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

**Modifications to the Statement of Work:** Requests to modify this SoW must be made through the Contracting Officer's Technical Representative (COTR) who submits the modification for approval to the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the CIE within 10 working days after receipt of all required information of the decision on substitutions. The COTR can approve changes to the milestone dates, list of pre-review documents, and Terms of Reference (ToR) of the SoW as long as the role and ability of the CIE reviewer to complete the SoW deliverable in accordance with the ToRs and deliverable schedule are not adversely impacted. The SoW and ToRs cannot be changed once the peer review has begun.

**Acceptance of Deliverables:** Upon review and acceptance of the CIE independent peer review reports by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, these reports shall be sent to the COTR for final approval as contract deliverables based on compliance with the SoW. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (the CIE independent peer review reports) to the COTR (William Michaels, via [William.Michaels@noaa.gov](mailto:William.Michaels@noaa.gov)).

**Applicable Performance Standards:** The contract is successfully completed when the COTR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards: (1) the CIE report shall have the format and content in accordance with Annex 1, (2) the CIE report shall address each ToR as specified in Annex 2, (3) the CIE reports shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

**Distribution of Approved Deliverables:** Upon notification of acceptance by the COTR, the CIE Lead Coordinator shall send via e-mail the final CIE reports in \*.PDF format to the COTR. The COTR will distribute the approved CIE reports to the NMFS Project Contact and regional Center Director.

**Key Personnel:**

William Michaels, Contracting Officer's Technical Representative (COTR)  
NMFS Office of Science and Technology  
1315 East West Hwy, SSMC3, F/ST4, Silver Spring, MD 20910  
[William.Michaels@noaa.gov](mailto:William.Michaels@noaa.gov) Phone: 301-713-2363 ext 136

Manoj Shivilani, CIE Lead Coordinator  
Northern Taiga Ventures, Inc.  
10600 SW 131<sup>st</sup> Court, Miami, FL 33186  
[shivlanim@bellsouth.net](mailto:shivlanim@bellsouth.net) Phone: 305-383-4229

Kevin Hill, NMFS Project Contact  
Fisheries Resources Division, Southwest Fisheries Science Center,  
8604 La Jolla Shores Dr., La Jolla, CA 92037  
[Kevin.Hill@noaa.gov](mailto:Kevin.Hill@noaa.gov) Phone: 858-546-7052

**Annex 1: Format and Contents of CIE Independent Peer Review Report**

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations.
2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR, and Conclusions and Recommendations in accordance with the ToRs.
  - a. The CIE reviewer shall describe in their own words the review activities completed during the panel review meeting, including providing a detailed summary of findings, conclusions, and recommendations.
  - b. The CIE reviewer shall discuss their independent views on each ToR even if these were consistent with those of other panelists, and especially where there were divergent views.
  - c. The CIE reviewer shall elaborate on any points raised in the Summary Report that they feel might require further clarification.
  - d. The CIE reviewer shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.
  - e. The CIE independent report shall be a stand-alone document for others to understand the proceedings and findings of the meeting, regardless of whether or not they read the summary report. The CIE independent report shall be an independent peer review of each ToRs, and shall not simply repeat the contents of the summary report.
3. The reviewer report shall include as separate appendices as follows:
  - Appendix 1: Bibliography of materials provided for review
  - Appendix 2: A copy of the CIE Statement of Work
  - Appendix 3: Panel Membership or other pertinent information from the panel review meeting.



## **Annex 2: Terms of Reference for the Peer Review**

### **STAR Panel Review of Pacific Sardine Stock Assessment**

The CIE reviewer is one of the four equal members of the STAR panel. The principal responsibilities of the STAR Panel are to review stock assessment documents, data inputs, analytical models, and to provide complete STAR Panel reports. The main goal of this review is to provide an independent evaluation of the process, data, model, and outcomes of the Pacific sardine STAR panel review.

Along with the entire STAR Panel, the CIE Reviewer's duties include:

1. reviewing draft stock assessment documents and other pertinent information (e.g.; previous assessments and STAR Panel reports);
2. working with STAT Teams to ensure assessments are reviewed as needed;
3. documenting meeting discussions;
4. providing evaluation and recommendations regarding data quality, analytic methodologies, model assumptions, estimates, uncertainty, result interpretation and conclusions
5. recommending alternative methods and/or modifications of proposed methods, as appropriate during the STAR Panel meeting;
6. reviewing summaries of stock status (prepared by STAT Teams) for inclusion in the Stock Assessment and Fishery Evaluation (SAFE) document, and;
7. providing an explicit statement as to whether this assessment represents the best available science.

The STAR Panel, including the CIE Reviewer, is responsible for determining if a stock assessment or technical analysis is sufficiently complete. It is their responsibility to identify assessments that cannot be reviewed or completed for any reason. The decision that an assessment is complete should be made by Panel consensus. If agreement cannot be reached, then the nature of the disagreement must be described in the Panels' and CIE Reviewer's reports.

The review solely concerns technical aspects of the sardine stock assessment. It is therefore important that the Panel strive for a risk neutral perspective in its reports and deliberations. Assessment results based on model scenarios that have a flawed technical basis, or are questionable on other grounds, should be identified by the Panel and excluded from the set upon which management advice is to be developed. The STAR Panel should comment on the degree to which the accepted model scenarios describe and quantify the major sources of uncertainty Confidence intervals of indices and model outputs, as well as other measures of uncertainty that could affect management decisions, should be provided in completed stock assessments and the reports prepared by STAR Panels.

Recommendations and requests to the STAT Team for additional or revised analyses must be clear, explicit, and in writing. A written summary of discussion on significant technical points and lists of all STAR Panel recommendations and requests to the STAT Team are required in the STAR Panel's report. This should be completed (at least in draft form) prior

to the end of the meeting. It is the chair and Panel's responsibility to carry out any follow-up review of work that is required.

### **Annex 3: Tentative Agenda**

The meeting agenda has not yet been finalized, but will be forwarded by the NMFS Project Contact at least two weeks before the meeting.

#### Monday 21 September

08h00 Introductions	Punt
Facilities, e-mail, network, etc.	Lo
Work plan and Terms of Reference	Burner
Report Outline and Appointment of Rapporteurs	Punt
08h30 Pacific sardine assessment presentation	Hill
10h30 Break	
11h00 Panel discussion requests	Panel
12h30 Lunch	
13h30 Pacific sardine assessment presentation	Hill
17h00 Close	

#### Tuesday & Wednesday 22 – 23 September

08h00 Pacific sardine responses	Hill
10h30 Break	
11h00 Discussion and requests	Panel
12h30 Lunch	
13h30 Pacific sardine reprise	Hill
15h00 Break	
15h30 Pacific sardine reprise	Panel
17h00 Close	

#### Thursday 24 September

08h00 Pacific sardine responses	Hill
10h30 Break	
11h00 Discussion (report)	Panel
12h30 Lunch	
13h30 Report writing	Panel
16h00 Public comment general issues	
17h00 Close	

#### Friday 25 September

08h00 Pacific sardine responses	Hill
10h30 Break	
11h00 Report preparation	Panel
12h30 Lunch	
13h30 Report preparation	Panel
15h00 Close	

**Annex 4: STAR Panel Summary Report (Template)**

- Names and affiliations of STAR Panel members
- List of analyses requested by the STAR Panel, the rationale for each request, and a brief summary the STAT responses to each request
- Comments on the technical merits and/or deficiencies in the assessment and recommendations for remedies
- Explanation of areas of disagreement regarding STAR Panel recommendations
  - Among STAR Panel members (including concerns raised by the CPSMT and CPSAS representatives)
  - Between the STAR Panel and STAT Team
- Unresolved problems and major uncertainties, e.g., any special issues that complicate scientific assessment, questions about the best model scenario, etc.
- Management, data or fishery issues raised by the public and CPSMT and CPSAS representatives during the STAR Panel
- Prioritized recommendations for future research and data

### **Appendix 3. Panel Membership and other pertinent information from meeting**

#### **STAR Panel Members:**

André Punt (Chair), Scientific and Statistical Committee (SSC), University of Washington  
 Selina Heppell, SSC, Oregon State University  
 Dvora Hart, External Reviewer, Northeast Fisheries Science Center, Woods Hole  
 John Wheeler, Center for Independent Experts (CIE)

#### **Pacific Fishery Management Council (Council) Representatives:**

Briana Brady, Coastal Pelagic Species Management Team (CPSMT)  
 Mike Okoniewski, Coastal Pelagic Species Advisory Subpanel (CPSAS)  
 Mike Burner, Council Staff

#### **Pacific Sardine Stock Assessment Team:**

Kevin Hill, NOAA / SWFSC  
 Nancy Lo, NOAA / SWFSC  
 Beverly Macewicz, NOAA / SWFSC  
 Paul Crone, NOAA / SWFSC

#### **Aerial Survey Team**

Tom Jagielo, Tom Jagielo Consulting  
 Ryan Howe, West Coast Sardine Survey  
 Doyle Hanan, Hanan and Associates, for CWPA

#### **Others in Attendance**

John Butler, NMFS, SWFSC, La Jolla, CA  
 Richard Carroll, Ocean Gold Seafoods  
 Ray Conser, NMFS, SWFSC, La Jolla, CA  
 David Haworth, Fisherman, San Diego, CA  
 Jime Humphrys, Marine Stewardship Council, Seattle, WA  
 Steve Joner, Makah Tribe  
 Darrell Kapp, Astoria Pacific Seafoods  
 Greg Krutzikowsky, Oregon Dept. of Fish and Wildlife, Newport, OR  
 Hui-hua Lee, NMFS, SWFSC, La Jolla, CA  
 Josh Lindsay, NMFS, Southwest Regional Office  
 Mark Maunder, Inter-American Tropical Tuna Commission (IATTC), La Jolla, CA  
 Sam MccClatchie, NMFS, SWFSC, La Jolla, CA  
 Jenny Mc Daniel, NMFS, SWFSC, La Jolla, CA  
 Kevin Piner, NMFS, SWFSC, La Jolla, CA  
 Diane Pleschner-Steele, CWPA  
 Bob Seidel, Astroia Holdings, Inc.  
 Alexandre Silva, IATTC, La Jolla, CA  
 Christina Show, NMFS, SWFSC, La Jolla, CA  
 Kevin Steinhof, NMFS, SWFSC, La Jolla, CA  
 Dale Sweetnam, California Dept. of Fish and Game, La Jolla, CA  
 Andrew Thompson, NMFS, SWFSC, La Jolla, CA

Jerry Thon, Astroia Holdings, Inc.  
Russ Vetter NMFS, SWFSC, La Jolla, CA, Fisheries Research Division, Director  
Rob Zuanich, Purse Seine Vessel Owners Association